AD-A034 445

THE TESTING OF A REGRESSION MODEL FOR
PREDICTING THE PROGRESSION INDEX IN
VARIOUS ARMY COURSES

ARMY TRAINING SUPPORT CENTER
FORT EUSTIS, VIRGINIA

15 OCTOBER 1976

019059

TRADOC

CTS

PROJECT ABACUS

ADA031445

Report CTD-TR-76-3

AD_____

THE TESTING OF A REGRESSION MODEL
FOR PREDICTING THE PROGRESSION INDEX IN
VARIOUS ARMY COURSES

John Leo Howlett, Ph.D.

15 October 1976

DDC
JAN 18 1977

Prepared for:
US ARMY TRAINING AND DOCTRINE COMMAND
Fort Monroe, Virginia 23651

SOLDIER COMMUNICATORS
FORT GORDON
HOME OF THE SIGNAL CORPS

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CTD-TR-76-3	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* The Testing of a Regression Model for Predicting the Progression Index in Various Army Courses		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) John Leo Howlett, Ph.D.		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Training Support Center Communicative Technology Directorate Fort Gordon, Georgia 30905		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Training Support Center Communicative Technology Directorate Fort Eustis, Virginia 23604		12. REPORT DATE 15 October 1976
		13. NUMBER OF PAGES 37
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Distribution of the document is unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

The idea for this study was planted during active duty for training of a USAR officer with Project ABACUS. It was completed later for the project and to satisfy a requirement for a staff study, USAC & GSC.

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Project ABACUS
Repair Courses
Self-Paced Training Efficiency
Electronics Aptitude Test (EL)

Surveillance & Communications Test (SC)
Progression Index (PI)
Relationship
Prediction

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This study was designed to establish whether a relationship exists between the Electronics Aptitude Score (EL), the Surveillance and Communications Score (SC) the independent variables, and the progression index of student learning, the dependent variable. The study was also designed to develop a regression equation for the purpose of prediction of student actual training time based on the two scores, EL and SC. The results could then be used to establish a graduation prediction and subsequent assignment of the student to his unit.

DD FORM 1 JAN 73 **1473** EDITION OF 1 NOV 65 IS OBSOLETE

ii

FOREWORD

Dr. John Leo Howlett (MAJ, USAR) prepared this study for Project ABACUS
and as a part of the course requirements of the US Army Command and
General Staff College.

This study was designed to establish whether a relationship exists
between the Electronics Aptitude Score (EL), the Surveillance and Com-
munications Score (SC), the independent variables, and the Progression
Index (PI) of student learning, the dependent variable. The study was
also designed to develop a regression equation for the purpose of pre-
diction of student actual training time based on the two scores, EL and
SC. The results could then be used to establish a graduation prediction
and subsequent assignment of the student to his unit.

ROBERT G. FOSTER
LTC, SigC
Program Director, Project ABACUS

iii

TABLE OF CONTENTS

THE TEST OF A REGRESSION MODEL
FOR PREDICTING THE PROGRESSION INDEX
IN VARIOUS ARMY COURSES

I.   INTRODUCTION

"The current thrust of Army thinking and planning in general
is to bring about significant increments in training proficiency for
a given time period and/or to bring about a given level of proficiency
with a significant decrease in training."   (Howard, 1975)

In August, 1972, Project ABACUS was begun in order to imple-
ment the training objectives of the Army as stated by Col. Howard in
the Discussion Guide, CTS Consultants Panel. In October, 1973, the
United States Army Signal School (USASIGS) was selected as the proto-
type test site for the development of a computerized training system
(CTS). On November 29, 1973, the Army designated three courses for
the operational test of the CTS as follows:

    1.   Field Radio Repair Course (31E20)

    2.   Teletypewriter Equipment Repair Course (31J20)

    3.   Avionics Communications Equipment Repair Course (35L20)

These courses were selected based on the following criteria:

    1.   Systems engineered

    2.   Self paced

    3.   Multi media

    4.   Performance oriented

Appendix I contains the topic outlines of the three courses selected
for the research project.

Common to all the students entered into the three courses
selected were two basic military entrance scores: Electronics
Aptitude Test (EL) and Surveilance and Communications Test (SC).

Members of Project ABACUS indicated that these two scores might possibly

provide the school with predictive capability regarding the efficiency

of student training in reference to time. It was therefore decided

that research model be designed which would yield a predictive equation

relating student progress with the two independent variables Electronics

Aptitude Score (EL) and Surveilance and Communications Score (SC).

II. STATEMENT OF THE PROBLEM

This study was designed to establish whether a relationship

exists between the Electronics Aptitude Score (EL), the Surveilance and

Communications Score (SC), the independent variables, and the progression

index of student learning, the dependent variable. The Progression

Index (PI) is defined as:

$$PI = \frac{\text{Actual Training Time - Hours Absent}}{\text{Total Training Time Authorized}}$$

The study was also designed to develop a regression equation for the

purpose of prediction of student actual training time based on the

two scores EL and SC. The results could then be used to establish

a Graduation Prediction and subsequent assignment of the student to

his unit.

III. DEFINITION OF TERMS

The following definitions were included for purposes of standardizing the use of terms in the study. Other terms or phrases used in the study were considered to be self-explanatory.

31E20 - is the course Field Radio Repair

31J20 - is the course Teletypewriter Equipment Repair

35L20 - is the course Avionics Communications Equipment Repair

CTS - is Computerized Training System

EL - is Electronics Aptitude Score

PI - is Progression Index - a mathematical ratio indicating the rate of student progress compared to a base course completion time.

SC - is Surveilance and Communications Score

SPSS - is Statistical Package for Social Sciences

USASIGS - is United States Army Signal School

IV. RELATED LITERATURE

There has been much study in regard to prediction of achievement in almost every field of study. In studying the sources of information it was found that in each article there was a significant prediction of success. The conclusions of the author in general were that there was enough increase in correlation with the use of multiple regression procedure to warrant its use for prediction of success. It was also a general concensus of opinion that further study in this area of success prediction was warranted.

Wampler attempted to select measures of aptitude which could be used effectively to predict performance in college mathematics. The study concerned only the selection of measures for a prediction scheme and not with a factor analysis of ability in mathematics. (Wampler, 1966) The subjects were chosen from a group of students who had completed ten semester hours of integrated courses in calculus and analytic geometry at Nebraska Wesleyan University. The tests used were taken from the French, Ekstrom, and Price aptitude factors kit (French, 1963) The actual tests chosen were:

X_1 = Location Test

X_2 = Addition Test

X_3 = Division Test

X_4 = Subtraction and Multiplication Test

X_5 = Mathematics Aptitude Test

X_6 = Necessary Arithmetic Operations Test

X_7 = Inference Test

X_8 = Wide Range Vocabulary Test

X_9 = Cube Comparison Test

X_{10} = Match Provlems V

X_{11} = Surface Development Test

Each of the tests of aptitude was administered to the subject at the beginning of the school year. Upon completion of the course Mathematics 106, Calculus II, a standardized test in calculus was administered. The eleven aptitude measures were used as prediction variables and the calculus test score was used as the criterion variable. The entire set of scores was submitted to a linear regression analysis utilizing an IBM 1620 digital computer with a program written

by Griffith. (Wampler, 1963) The best combination of variables proved to be: Location Test, Division Test, Inference Test, Wide Range Vocabulary Test and Cube Comparison Test. The multiple correlation coefficient for this combination had the value .9502 which differed significantly from zero at the 1 per cent level and the regression equation for the best combination of these five variables was Calculus Test score equals $.4209X_1 - (.1498X_3) + .8930X_7 + .8238X_8 - .1601X_9 + 4.496$. Prediction of performance on the standardized calculus test using the aforementioned regression equation should not be wrong by more than 3.176 points in approximately two-thirds of the predictions one might make.

The results of this study indicated that measures of aptitude can be used effectively to predict achievement in college mathematics.

The purpose of the test conducted by Hulser and Smith (Hulser, 1963) was to find some means of predicting general grade point average of freshmen after one quarter of college work at Central Missouri State College. The experiment served a twofold purpose: The first step was to determine the validity of each of the tests of the freshman battery for predicting first quarter grade point average. The second aspect of the study was to determine whether a combination of two or more variables would produce a sufficient increase in validity to justify the use of multiple regression procedures.

The procedure began with the administration of the freshman battery consisting of the School and College Aptitude Test (SCAT) and the Missouri English Placement Test (MEPT). The high school percentile rank was also used in this combination. College grade point average computed from the first quarter grades served as the criterion

measure. All possible intercorrelations were computed between predictors as well as the criterion variables. The best single predictor of grade point average proved to be the high school rank, with a correlation of .6000.

In the second phase of the study, use was made of all possible combinations of tests. The best possible combination using linear regression procedures proved to be the use of the SCAT, verbal, and Quantitative MEPT and high school rank with a correlation of (.686). But since the combination of the SCAT total score and the high school rank was .671, only .015 less than the best possible combination, and the addition of each predictor does add a source of error, it was decided to use the regression equation:

$$Y = .017133X_1 + .013829X_2 - .110 \text{ where}$$

Y = Predicted grade point average

X_1 = Total SCAT score

X_2 = High school rank

The experiment did show that multiple regression procedures can improve prediction of grade point averages using SCAT, MEPT and high school grade point averages. Stiles and Williams at Vanderbilt University School of Engineering wished to find a means to select from among the applicants, those students having the best chance of success in college. (Stiles, 1963) Eight prediction variables were selected.

I. $CEEB_1$ - College Entrance Examination Board Scholastic Aptitude Tests Verbal Battery Score

II. $CEEB_M$ - College Entrance Examination Board Scholastic Aptitude Tests Mathematics Battery Score

III.   CEEB$_T$ -   College Entrance Examination Board

                        Scholastic Aptitude Tests - total score -

                        CEEB$_T$ + CEEB$_M$

IV.   IQ   -   Intelligence Quotient high school age

                        levels, based on a mean of 100 and

                        standard deviation of 15

V.   HS$_{GP}$ -   High school grade point average based on

                        a 3.0 system

VI.   HS$_{RA}$ -   High school percentile rank in class

VII.   Age   -   The age of applicant of September, 1959

VIII.   HS$_{RE}$ -   High school recommendations

                        The high school principal or counselor was

                        required to write a recommendation for

                        each applicant. Means of prediction were:

                        +1 - Student was given a positive

                        recommendation by the high school

                        0 - student given neutral recommendation

                        or no recommendation

                        -1 - student given a negative recommendation

IX.   G.P.A. -   Criterion variable grades were computed

                        from college grades using the same basis as

                        that for high school G.P.A.

The data collected was entered into a computer programmed to
compute the intercorrelation of the nine variables, the means, and
standard deviations of the variables. A multiple regression procedure
by the Fisher - Doolittle method was employed to give the best pre-
diction combination of the variables. The prediction equation was G.P.A.
(predicted) - 2.4816 + .0011 CEEB$_V$ + .0027 CEEB$_M$ + .4774 HS$_{G.P.}$ + 1.1207 HS$_{RE}$

The authors were quite interested in the fact that the high school ratings by the principal or counselor proved to be of significant value. In fact, the authors recommended an improvement on the rating scale to increase the predictability. This scale would use the ratings: 5, superior college student; 4, good student material; 3, student has minimum qualifications for college; 2, there is doubt of success of the student in college work; 1, student is not qualified to do college work.

The purpose of a study by Ivanoff and DeWane was to determine whether on the basis of certain available criteria, it was possible to discriminate between students who successfully completed ninth-grade algebra and those who completed the general mathematics program. (Ivanoff, 1965) This study differed from previous investigations of the problem not only with regard to the variable under scrutiny but also with the design. The subjects were taken from a large midwestern suburban non tax supported high school open to male students. The group was divided into 286 algebra students and 162 general mathematics students. The variables selected were: I.Q. rating, reading, arithmetic, language, and composite scores from the High School Placement Test (HSPT) and eighth grade mathematics marks. Grades were based on A-5, B-4, C-3, D-2, F-1. The hypothesis tested was that there is no significant relationship between the two groups and the prediction variables adopted.

The design of the experiment was set up as a regression scheme using a dichotomous variable rather than the usual numerical variable. Thus because the usual regression procedure was not appropriate an adaptation of the Fisher discriminant analysis was

made. (Fisher, 1936) Data was processed by an IBM 1620 digital computer using a two group multiple variable stepwise discriminant analysis.

The result of the experiment indicated that there was a significant difference between the two groups and that prediction could be made as to the success of students in the two groups. The prediction equation was $Z_{AM} + -.01255X_2 - .02333X_3 - .00250X_5 - .09246X_6 + 1.75442$ where Z_{AM} = The algebra general mathematics prediction score

$$X_2 = \text{(HSPT)} \quad \text{Reading}$$

$$X_3 = \text{(HSPT)} \quad \text{Arithmetic}$$

$$X_5 = \text{(HSPT)} \quad \text{Composite}$$

$$X_6 = \text{8th grade class work}$$

In prediction, if the Z score was negative it predicted achievement in Algebra whereas a positive score predicted achievement in General Mathematics. It was further pointed out the students found to be on the border line could be counselled in such a way that they would understand and be encouraged to "beat the odds" through diligent study and work habits.

V. PURPOSE OF THE STUDY

The purpose of this study was to develop a predictive equation which would adequately provide a training school with a tentative student training completion time. This predictive equation was to be dependent on a criterion based training program utilizing self-paced instruction techniques.

VI. NEED FOR THE STUDY

A systematic approach to education designed to increase training efficiency and decrease training time requires a specific prediction capability so that control on expected student progress can be met. The primary purpose of project ABACUS is to establish a training system which will bring about a given level of proficiency with a significant decrease in training time. Data has been collected from various courses taught by means of self-paced instruction. For each student completing a course, a progress index has been computed. A basic assumption is that instruction under project ABACUS will provide at least the same minimal progression index for a student with a similar background as found under self-paced instruction. Therefore it is essential to establish some viable predictive equation which might indicate the Progression Index for students utilizing the Computerized Training System (CTS).

VII. LIMITATIONS OF THE STUDY

Although this study was established to develop a predictive equation for student training under project ABACUS, the author was limited to the use of two variables as a means of developing the regression model.

1. Electronics score

2. Surveilance and communications score

The research model also limited itself to the three courses chosen for the Project ABACUS model.

1. Field Radio Repair (31E20)

2. Avionics Communications Equipment Repair (35L20)

3. Teletypewriter Equipment Repair Course (31J20)

VIII. DESIGN OF THE STUDY

The primary purpose of this study was to find a means of predicting

course completion time of students entering into three courses:

1. Field Radio Repair (31E20) 197 students

2. Teletypewriter Equipment Repair (31J20) 299 students

3. Avionics Communications Equipment Repair (35L20) 118 students

The criterion or dependent variables used in the study was defined

according to the following:

PROGRESSION INDEX (PI)

$$PI = \frac{\text{ACTUAL TRAINING TIME} - \text{HOURS ABSENT}}{\text{TOTAL TRAINING TIME AUTHORIZED}}$$

The design of the experiment required that the data used as the

independent variables be the EL and SC scores found in the serviceman's

entrance folder. It would have been desirable to include variables which

measured emotional adjustment, interest inventory and attitude toward

learning, but no such information was available. The prediction equations

were therefore based solely on the EL and SC scores.

The basic design of the experiment included a three phase study.

The first phase was the study of predictability of student progress in

the course 31E20. The population included 197 graduates who completed the

course during the period August 1974 through December 1975.

The second phase included the predictability of the student progression

index in the course 31J20 and included 299 students who completed the

course during the period August 1974 through December 1975.

Phase III utilized the regression model for the 35L20 courses and included

118 students who were enrolled during the period August 1974 through

December 1975.

The data for all three phases was accumulated and then processed by The University of Wisconsin, Green Bay, utilizing the Statistical Package for Social Sciences (Nie, 1975). The experiment utilized Multiple Linear Regression Analysis to establish a best fit use of the independent variables to establish a predictive Progression Index (PI). The 5% level of confidence was used in the nul hypotheses.

There were three nul hypotheses tested:

H 1. There was no multiple correlation of the independent variables EL and SC with the dependent variable PI in the course 31E20.

H 2. There was no multiple correlation of the independent variables EL and SC with the dependent variable PI in the course 31J20.

H 3. There was no multiple correlation of the independent variables EL and SC with the dependent variable PI in the course 35L20.

IX. ANALYSIS OF THE DATA

Phase I

Phase I was designed to establish whether or not the combination of the two scores EL and SC could, by means of linear regression methods, predict the Progression Index of a student in the course 31E20. The parent population for this phase consisted of 197 students who had graduated from the United States Army Signal School course, Field Radio Repair during the period August 1974 through December 1975.

The investigation utilized a linear regression model and management of the procedure was accomplished by the use of the Statistical Package for Social Sciences (SPSS). The nul hypothesis tested was:

H 1. There was no multiple correlation of the independent variables EL and SC with the dependent variable PI in the course 31E20.

Computations were performed which gave the arithmetic averages, the variance and the correlations of the independent variables with the dependent variables (Table 10).

Table I
Course 31E20
Means, Standard Deviation, and Correlations with PI

Variables	Cases	Mean	Std. Dev.	R
El	197	113.502	13.242	-.375
SC	197	107.162	15.819	-.250
PI	197	.85	.1953	1

Table II contains the results of the regression model utilizing the two independent variables EL and SC. As indicated in Table II, the regression multiple R (.37534) did not substantially improve over that of the simple R established in Table I. The F ratio for the regression model 15.907 with degrees of freedom at 2,194 was found to be significant at the 5% level of confidence. We, therefore, reject the nul hypothesis and conclude that there was no multiple correlation of the EL and SC scores with that of the PI. In order to establish the possibility of a non linear relationship, the data was plotted by means of a scattergram to identify possible linear transformations which would establish a viable regression model. One hundred data points were randomly selected and plotted and the results (Table III and Table IV) indicate a shotgun

pattern. The scattergrams indicate little likelihood of any possible

predictability of PI through the use of the EL and SC scores.

Table II
Multiple Regression Analysis (31E20)

Multiple-R   .37534

R-Square   .14088

Adjusted R-Square   .13648

Standard Error   18.19388

Variables in the Equation

Variable	B	Beta	Std. Error B	F
V2	-.5855297	-.3970399	.1391042	17.7181
V3	3.8946208E-02	3.1547278E-02	.1164471	.1119
(Constant)	147.2855			

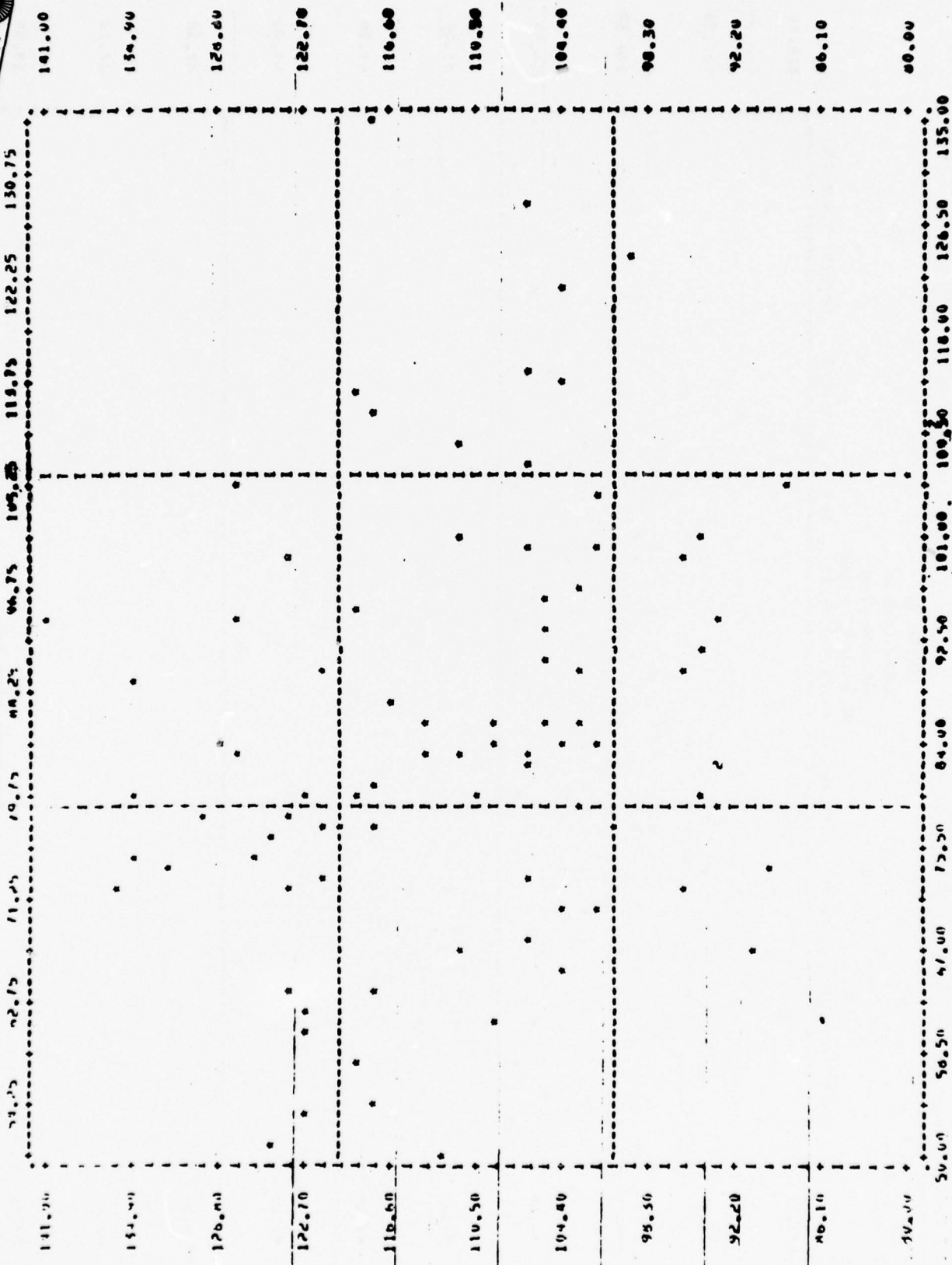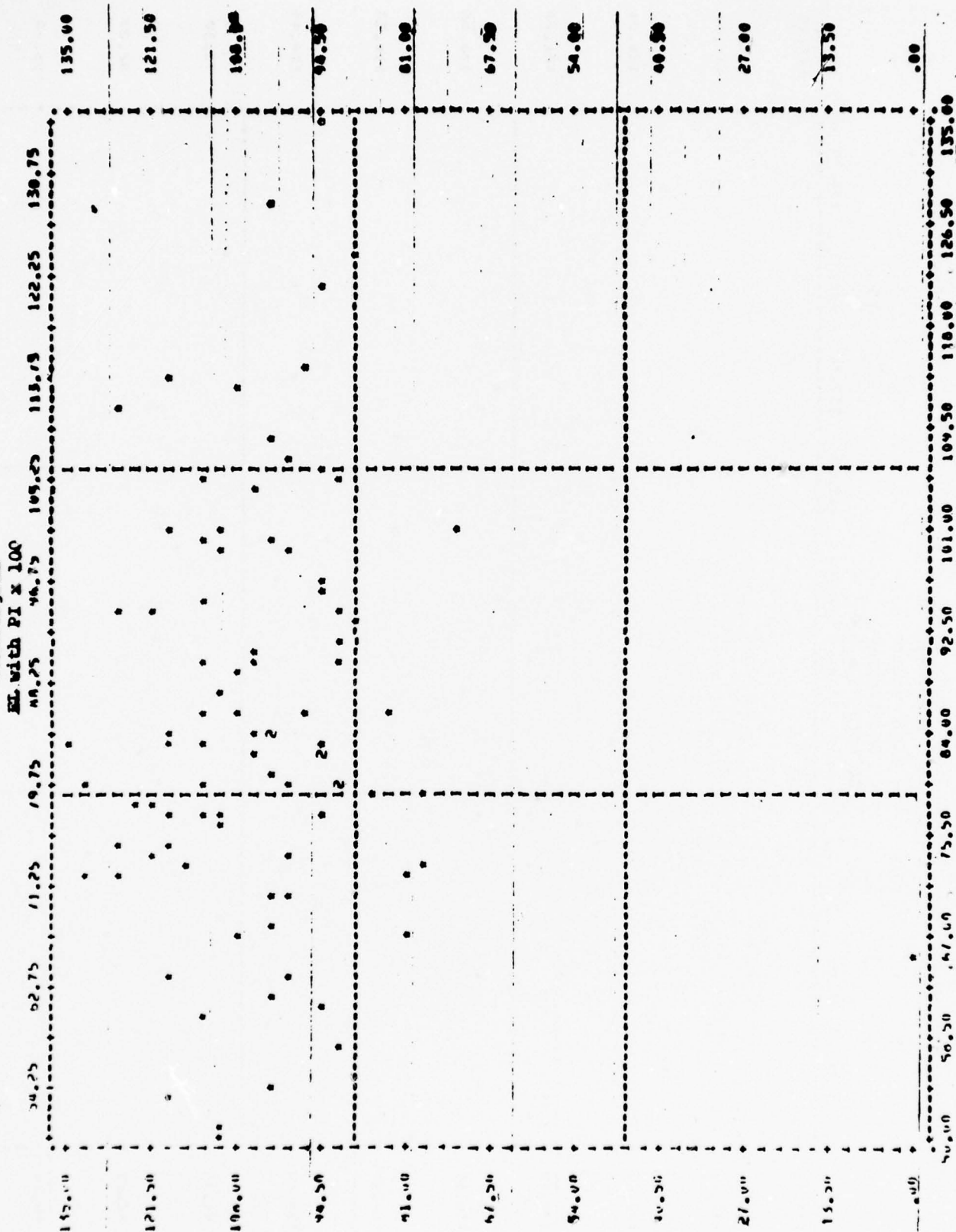| Analysis of Variance	DF	Sum of Squares	Mean Square	F
Regression	2	10530.655	5265.3273	15.90650
Residual	194	64217.345	331.01724	

TABLE III
31E20 Course
Scattergram
SC with PI x 100

TABLE IV
31E20 Course
Scattergram
EL with PI x 100

Phase II

The second phase was designed to establish whether or not the combination of the serviceman's two scores EL and SC could, by means of linear regression tecnniques, predict the progression index of a student in the course 31J20. The parent population for phase was made up of 299 students who had graduated from the United States Army Signal School course Teletypewriter Equipment Repair during the period August 1974 through December 1975.

This investigation utilized a linear regression model and management of the procedure was accomplished by use of the SPSS package. The null hypothesis tested was:

> H 2. There was no multiple correlation of the independent
> variables EL and SC with the dependent variable PI in
> the course 31J20.

Computations were performed which gave the arithmetic averages, the variance, and the correlation of the independent variables with the dependent variables (Table V). Table VI contains the results of the

Table V
Course 31J20
Means, Standard Deviation, and Correlations with PI

Variable	Cases	Mean	Std. Dev.	R
EL	299	111.120	12.836	-.1707
SC	299	107.498	14.036	-.1222
PI	299	.7529	.181	

regression model utilizing the two independent variables EL and SC. As indicated in Table VI, the regression multiple R (.17065) did not substantially improve over that of the simple R established in Table V. The F ratio for the regression model 4.439 with degrees of freedom at 2,296 was found to be significant at the 5% level of confidence.

We, therefore, reject the null hypothesis and conclude that there was no multiple correlation of the EL and SC scores with that of the PI in the course 31J20. In order to establish the possibility of nonlinear relationship, the data was plotted by means of a scattergram to identify possible linear transforms which would establish a viable regression model. Table VII and Table VIII indicate no basic transforms identifiable. The shotgun pattern indicates no likelihood of predictability of the PI by use of the EL and SC scores.

<div align="center">

Table VI
Multiple Regression Analysis (31J20)

</div>

Multiple-R	.17065
R-Square	.02912
Adjusted R-Square	.02585
Standard Error	15.00826

<div align="center">

Variables in the Equation

</div>

Variable	B	Beta	Std. Error B	F
V2	-.2022588	-.1710223	9.7214340E-02	4.3287
V3	5.5782446E-04	5.1576008E-04	8.8904877E-02	.0000
(Constant)	97.70274			

Analysis of Variance	DF	Sum of Squares	Mean Square	F
Regression	2	1999.9269	999.96345	4.43939
Residual	296	66673.337	225.24776	

TABLE VII
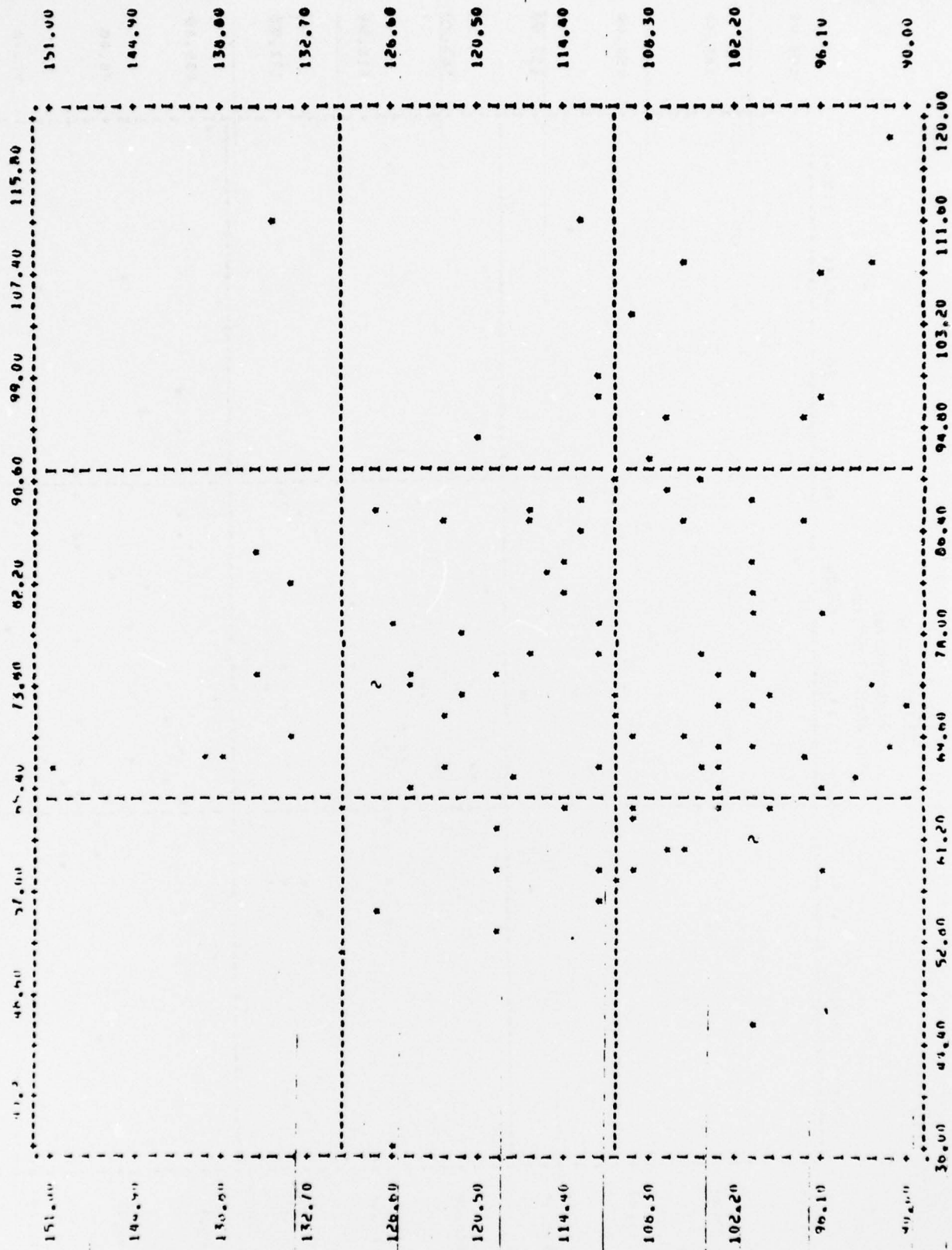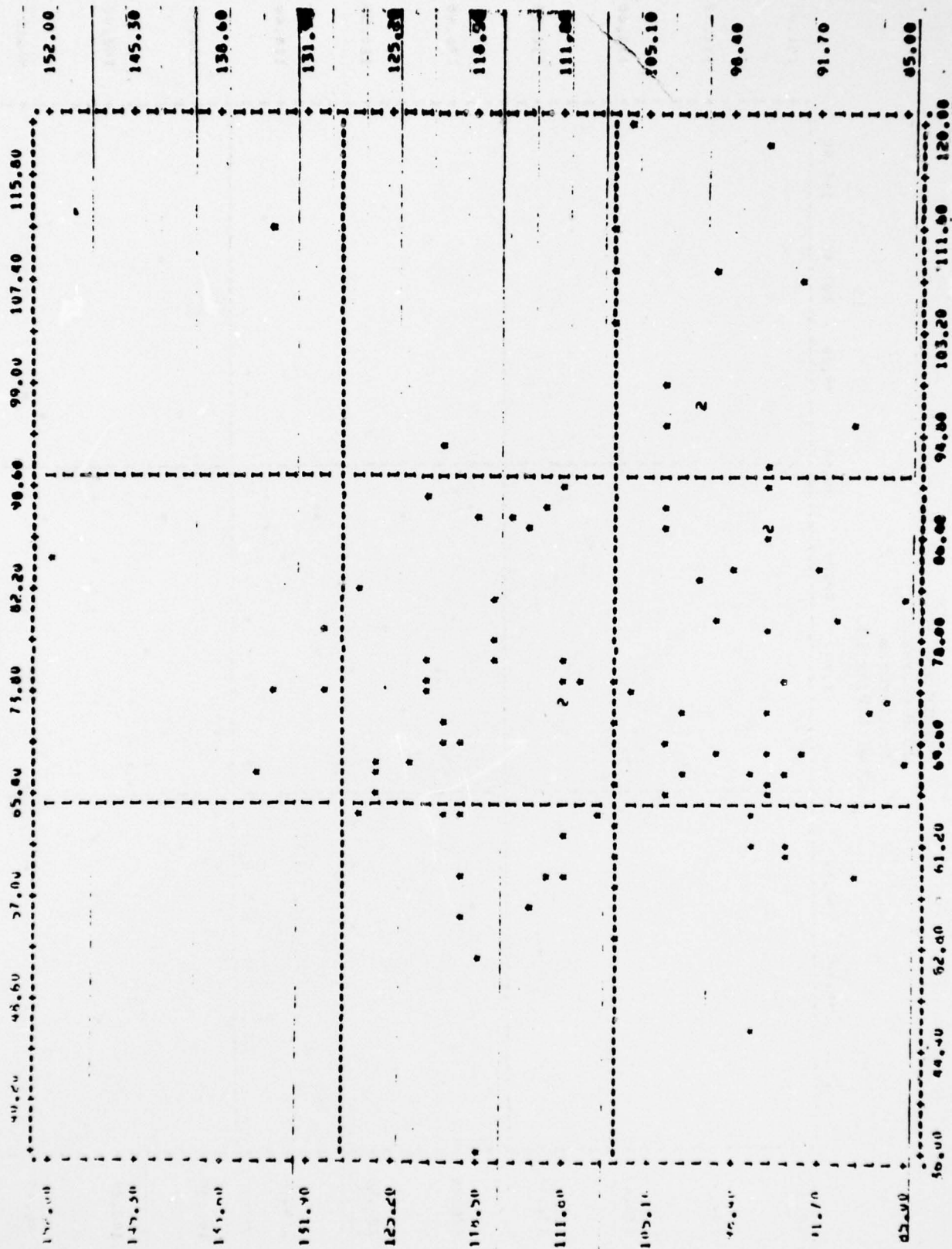31J20 Course
Scattergram
SC with PI x 100

TABLE VIII
31J20 Course
Scattergram
EL with PI x 100

Phase III

Phase III was designed to establish whether or not the combination of the serviceman's two scores EL and SC would, by means of linear regression techniques, predict the progression index of a student in the course 35L20. The parent population for this phase was made up of 118 students who had completed the 35L20 course at the United States Army Signal School during the period August 1974 through December 1975.

This investigation utilized a linear regression model and management of the procedure was accomplished by use of the SPSS package. The null hypothesis tested was:

H 3.   There was no multiple correlation of the independent

variables EL and SC with the dependent variable PI in

the course 35L20.

Computations were performed which gave the arithmetic averages, the variance and the correlation of the independent variables with the dependent variable in the 35L20 course (Table IX). Table X contains the results of the regression model utilizing the two independent variables EL and SC. As indicated in Table X the regression multiple R (.2546) did not show substantial improvement over that of the simple R established in Table IX. The F ratio for the regression model 3.986 with degress of freedom at 2;115 again was found to be significant at the 5% level of confidence (F at 5% is 3.09). The scattergrams Tables XI and XII indicate the typical shotgun pattern and thus no attempts were made to establish linear transforms for the regression model.

Table IX
Course 35L20
Means, Standard Deviation, and Correlation with PI

Variable	Cases	Mean	Std. Dev.	R
EL	118	119.390	12.293	-.2206
SC	118	114.000	12.293	-.2480
PI	118	.93	.2111	

Table X
Multiple Regression Analysis (35L20)

Multiple-R	.25463
R-Square	.06483
Adjusted R-Square	.05677
Standard Error	20.59076

Variables in the Equation

Variable	B	Beta	Std. Error B	F
V2.	-.1384431	-8.4618876E-02	.2160202	.4107
V3	-.3197061	-.1861723	.2267390	1.9882
(Constant)	146.9582			

Analysis of Variance	DF	Sum of Squares	Mean Square	F
Regression	2	3380.3527	1690.1764	3.98646
Residual	115	48757.613	423.97925	

TABLE XI
35L20 Course
Scattergram
SC with PI x 100

23

TABLE XII
35L20 Course
Scattergram
EL with PI x 100
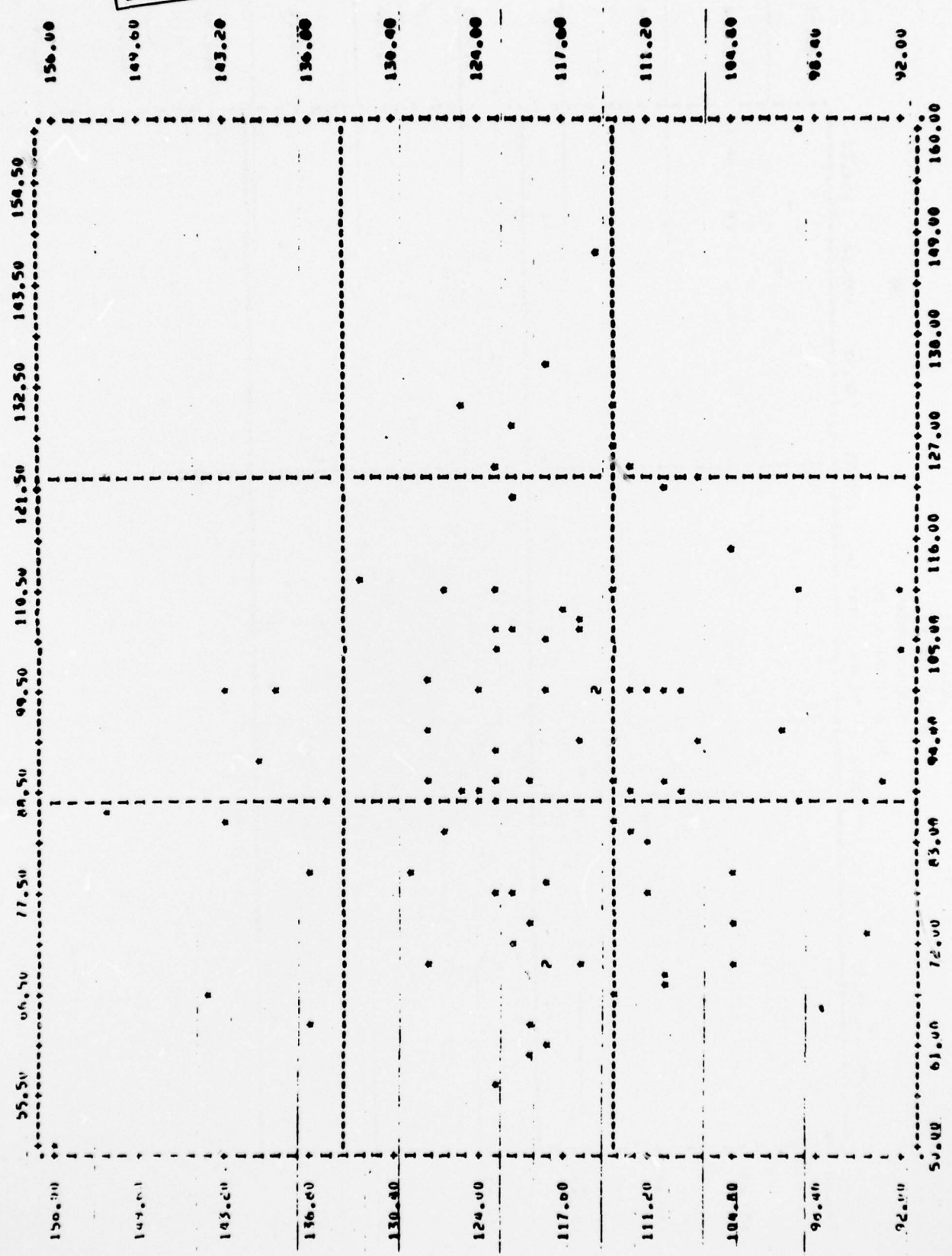
X. SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Restatement of the Problem

The study was initiated to ascertain whether or not the basic

soldier's entrance scores, the Electronics Score and the Surveilance

and Communications Score, can be used to predict the rate of course

completion and thus predict the course completion time of the soldier

in variuos signal courses at the United States Army Signal School.

Summary of the Findings

The study was devided into three phases which analyzed the

use of a multiple regression model on the three courses:

31E20   Field Radio Repair

31J20   Teletypewriter Equipment Repair

35L20   Avionics Communications Equipment Repair

In all three phases the analysis of the data indicated that there was no

multiple linear relationship between the Progression Index, the dependent

variable, and the EL and SC scores, the independent variables. Scatter-

grams of the data also indicated little or no possibility of the use of

linear transforms for prediction improvement.

Conclusions

The results of this study indicate that the use of the

Electronics Score and the Surveilance and Communications Score for the

prediction of courses completion time under self-paced instruction is

not warranted. Further, the use of multiple linear regression methods

does not improve the possibility of use of these two variables for

prediction of the Progression Index.

Implications

The results of this study show that though multiple regression techniques do provide a means of predicting program success, the use of the scores EL and SC do not indicate the rate of progression in a self-paced method of learning. Apparently self-paced learning is not dependent on aptitude type scores.

Suggestions for Further Study

The following are suggestions for further study:

1. This study indicates that further search for predictive type variables is needed to establish a student progression prediction equation.

2. Further study should be undertaken to identify the causes of self-paced rates of criterion learning. Apparently causes are quite diverse and vary greatly with the individual.

3. There is a possibility that the use of early subcourses could produce a highly predictive equation of final completion time of self-paced criterion courses.

BIBLIOGRAPHY

Best, John W., Research in Education. Englewood Cliffs, N.J: Prentice-
     Hall, Inc., 1963. 306 pp.

Borko, Harold, Computer Application in The Behavioral Sciences.
          Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1962. 606 pp.

Buros, Oscar Krison (Ed.), The Sixth Mental Measurements Yearbook
          New Jersey, The Gryphon Press, 1965.

Dykstra, Otto, Jr., "Multiple Regression Procedure" IBM 1620 General
          Program Library No. .06, .043, 1963.

Fisher, R.A., "The Use of Multiple Measurement in Taxonomic Problems."
          Annuls of Eugenics, VII, 1963.

French, J.W., Ekstrom, R.B. and Price, L.A., Kit of Reference Tests
          for Cognitive Factors, Education Testing Service, Princeton,
          New Jersey, 1963.

Garrett, Henry E., Statistics in Psychology and Education. New York:
          Longmans, Green and Co., 1953. 422 pp.

Good, Carter V., A.S. Barr, and Douglas E. Scates, The Methodology
          of Education Research. New York: Appleton Century Crofts, Inc.,
          1941. 588 pp.

Griffith, E.V., "Linear Regression Analysis of All Combinations of
          Variables," IBM 1620 General Program Library No. 6.0.057, 1963.

Hillway, Tyrus, Introduction to Research. Boston: Houghton Mifflin
          Company, 1956. 293 pp.

Hoel, Paul G., Introduction to Mathematics Statistics. New York:
          John Wiley & Sons, Inc., 1958. 305 pp.

Hulser, Lyle and Gary Smith, "A Study of the Validities of the Tests
          in the CMSC Freshmen Battery." Unpublished thesis, The Central
          Missouri State College, no date.

Hutson, Percival W., The Guidance Function in Education. New York:
          Appleton Century Crofts, Inc., 1958. 670 pp.

Ivanoff, John M. and DeWane Opraem, Evermode "Use of Discriminant
          Analysis for Selecting Students for Ninth-grade Algebra or
          General Mathematics." The Mathematics Teacher, May, 1965.

Johnson, Palmer O., Statistical Methods in Research. New York: Prentice-Hall, Inc., 1950. 357 pp.

Lindquist, E.F., Statistical Analysis in Educational Research. Boston: Houghton Mifflin Company, 1940. 257 pp.

Mueller, John H., and Karl F. Schessler, Statistical Reasoning in Sociology. Boston: Houghton Mifflin Company, 1961. 414 pp.

Nie, Norman H. et all, Statistical Package for The Social Sciences. New York: McGraw-Hill Book Company, 1975.

Richmond, Samuel B., Statistical Analysis. New York: The Ronald Press Company, 1964. 509 pp.

Snedecor, George W., Statistical Methods. Ames: The Iowa State University Press, 1956.

Stiles, Reaburn, and H.E. Williams, "A Multivariate Analysis of Admissions Criteria at Vanderbilt Engineering School," Journal of the Tennessee Academy of Science, Vol. 38, No. 1, pp. 37-39; January, 1963.

Underwood, Benton J., Carl P. Duncan, Janet A. Taylor and John W. Cotton, Elementary Statistics. New York: Appleton Century Crofts, Inc., 1954. 214 pp.

United States Army Signal Center, "Task Group Report Computor Assisted Instruction," Volume II, Prototype Test Plans, April, 1972.

Wampler, Joe F., "Prediction of Achievement in College Mathematics." The Mathematics Teacher, Vol, LIX, No. 4, pp. 364-369, April, 1966.

APPENDIX A

Field Radio Repair

31E20

Equipment	Time
RT 841/PRC-77 (T/S)	87
RT 841/PRC-77 (Align/Adjust & F/T)	54
OA-3633	36
RT-524/VRC	59
RT-246/VRC	69
AN/GRC-142	68
RT-662/GRC (T/S & repair)	56
RT-662/GRC (Align)	50
RT-662/GRC (F/T)	33
AMP 3349/GRC-106 (T/S)	25
AMP 3349/GRC-106 (Align/adjust)	23
AMP 3349/GRC-106 (F/T)	24
MD-522 A/GR (T/S)	21
MD-522 A/GR (Align/adjust)	45
Final Shop (Not tested)	42
	695

```
695 hrs - 19 weeks
Cobet  -  6 weeks
TOTAL    25 weeks
```

T/S = Troubleshoot
F/T = Final Test

30

APPENDICES

APPENDIX C

Avionics Communications Equipment Repair

35L20

Equipment	Time
AN/ARC-134 (T/S)	78
AN/ARC-54 (T/S)	26
AN/ARC-54 (F/T)	13
AN/ARC-131 (Align)	7
AN/ARC-131 (Adjust)	7
AN/ARC-131 (T/S)	17
C-1611/AIC (T/S)	7
AN/ARC-114	35
AN/ARC-115	32
AN/ARC-116	32
AN/ARC-51BX (Align)	34
AN/ARC-51BX (T/S)	49
AN/ARC-51BX (F/T)	11
AN/ARC-102 (T/S)	72
AN/APX-72 (Align)	19
AN/APX-72 (T/S)	68
	507

507 hrs - 14 weeks
Cobet   - 8 weeks
TOTAL   22 weeks

T/S - Troubleshoot
F/T - Final Test

APPENDIX B

Teletypewriter Equipment Repair Course

31J20

Proposed POI Content and Time

Equipment	Time
TT-4	94
AN/FGC-20	50
AN/FGC-159	38
TT-76	60
AN/FGC-161	85
AN/FGC-58	89
AN/FGC-80	100
AN/MGC-17	27
	543

543 hrs - 15 weeks
Cobet   -   6 weeks
        21 weeks